Government of Canada | Gouvernement du Canada
Canadian Forestry Service | Service canadien des forêts

Early infection of larch populations by the European larch canker *Lachnellula willkommii*

D.P. Ostaff and W.R. Newell

Information Report M-X-157
Canadian Foresty Service — Maritimes

86-04422/

CANADIAN FORESTRY SERVICE - MARITIMES

The Canadian Forestry Service - Maritimes is one of six regional establishments of the Canadian Forestry Service, within Agriculture Canada. The Centre conducts a program of work directed toward the solution of major forestry problems and the development of more effective forest management techniques for use in the Maritime Provinces.

The program consists of three major elements - research and development, technical and information services, and forest resources development. Most research and development work is undertaken in direct response to the needs of forest management agencies, with the aim of improving the protection, growth, and value of the region's forest resource for a variety of consumptive and nonconsumptive uses; studies are often carried out jointly with provincial governments and industry. The Centre's technical and information services are designed to bring research results to the attention of potential users, to demonstrate new and improved forest management techniques, to assist management agencies in solving day-to-day problems, and to keep the public fully informed on the work of the Maritimes Centre.

The forest resources development branch is responsible for development, implementation, and administration of joint federal/provincial forest resources development agreements in the three Maritime provinces, for the creation of employment opportunities in the development of the forest resources, and for providing economic information to landowners and decision-makers for identifying and evaluating forest management alternatives.

EARLY INFECTION OF LARCH POPULATIONS BY THE EUROPEAN LARCH CANKER *LACHNELLULA WILLKOMMII*

by

D.P. Ostaff and W.R. Newell

Government of Canada
Canadian Forestry Service - Maritimes
P.O. Box 4000, Fredericton, N.B. Canada E3B 5P7

Information Report M-X-157

1986

© Minister of Supply and Services, Canada 1986

Catalogue no. Fo46-19/157E
ISBN 0-662-14736-7
ISSN 0704-769X

Copies of this report may be obtained at no charge from

Canadian Forestry Service - Maritimes
P.O. Box 4000
Fredericton, N.B. Canada E3B 5P7

Une traduction française de ce rapport peu être mise sans frais à la disponibilité de quiconque en fait la demande.

ABSTRACT

Seedlings of some populations (seed sources) of Larix decidua developed symptoms of the European larch canker 1 year after being planted (2 years after being grown from seed) in an area with a high incidence of the disease. After 2 years, at least one seedling from 11 of 32 different populations of three Larix species became infected with the European larch canker. In an effort to find larch species (and hybrids) and provenances of the species suitable for reforestation programs consideration should be given to their susceptibility to the canker.

RÉSUMÉ

Des symptômes de chancre du mélèze d'Europe sont apparus chez certaines populations (origines des graines) de Larix decidua un an après la plantation (deux ans après le semis) dans une région où l'incidence de la maladie est élevée. Deux ans après la plantation, pour 11 des 32 populations différentes de trois espèces de mélèze, au moins un plant était infecté par le chancre. Dans la recherche d'espèces de mélèze (et d'hybrides) ainsi que des provenances convenant pour les programmes de reboisement, il faudrait tenir compte de la sensibilité au chancre.

INTRODUCTION

The larches, Larix spp., are potentially important tree species for reforestation programs. Their adaptability to a wide range of sites, rapid juvenile height growth, and high specific gravity make them particularly attractive for the production of pulp when grown on short rotations (Simpson 1982). Several provenance trials of tamarack (Larix laricina (Du Roi) K. Koch), European (L. decidua Mill.), Japanese (L. leptolepis (Sieb. & Zucc.) Gord), and hybrid larches in eastern Canada have indicated that rotations of 20-30 years are easily attainable for the production of pulpwood (Park and Fowler 1983). Larch, however, is vulnerable to attack by many insects and diseases, including the European larch canker caused by the fungus, Lachnellula willkommii (Hartig) Dennis. The cankers occur on both stems and branches and may result in stem deformities, weak points susceptible to breakage and mortality, as well as a reduction in radial increment of saplings (Boyce 1961).

In Europe, L. willkommii is reported to cause larch canker on L. europaea D.C., L. leptolepis, L. laricina, L. occidentalis Nutt. and L. gmelini (Rupr.) Litvin (Hahn and Ayres 1934; Kurkela 1983). Inoculation experiments show that L. willkommii will infect L. europaea, L. leptolepis, L. laricina, L. occidentalis and L. gmelini (Hahn and Ayres 1936; 1943). Since various provenances of larch demonstrate great differences in growth and form, their susceptibility to the canker, particularly when grown in regions other than their natural range, may also vary. Larix decidua from the high Alps were highly susceptible to canker and dieback in Britain, while those from lower elevations and from Austria showed considerable variability (Pawsey and Young 1969). Trials with L. gmelini in different European countries indicated some resistance, although attacks have been observed (Yde-Andersen 1979).

If larch is to become an important reforestation species in Canada, it may be necessary to select populations that are not susceptible to infection by the European larch canker. We report an early infection of some larch populations by L. willkommii in New Brunswick, Canada.

METHODS

In the spring of 1983, 30 populations representing five species of Larix (Table 1) were planted in an area in southern New Brunswick where native tamarack is heavily infected with European larch canker. The seedlings had been grown in a greenhouse from seed planted in January 1982.

On May 13, 1983, five replicates of each of 10 populations (total of 50 seedlings) were randomly planted throughout a plantation using a Pottiputki planting tool to yield 2 x 2 m spacing with five rows of 10 seedlings; every second row was staggered. On May 19, 10 replicates of an additional 20 populations (total of 200 seedlings), 10 rows of 20 seedlings at 2 x 2 m spacing, were added to those already planted. On June 13, 1985, two populations (total of 25 seedlings) of L. occidentalis, grown from seed planted in February 1985, were added to the plantation.

Seedlings were examined each spring and fall for signs of infection. Each seedling was also rated for vigor by observing the length of the current growth, the condition of the foliage, and the amount of dieback. Seedlings were then scored as 5=excellent, 4=good, 3=fair, 2=poor, and 0=dead.

RESULTS AND DISCUSSION

Snow and freezing temperatures followed by warm spring temperatures during the week after the May 13, 1983 planting were probably responsible for killing 100% of the seedlings in eight of the Larix populations.

During the fall of 1984, one year after planting, the first ascocarps resembling L. willkommii were observed on the stems of three seedlings, one

INTRODUCTION

The larches, Larix spp., are potentially important tree species for reforestation programs. Their adaptability to a wide range of sites, rapid juvenile height growth, and high specific gravity make them particularly attractive for the production of pulp when grown on short rotations (Simpson 1982). Several provenance trials of tamarack (Larix laricina (Du Roi) K. Koch), European (L. decidua Mill.), Japanese (L. leptolepis (Sieb. & Zucc.) Gord), and hybrid larches in eastern Canada have indicated that rotations of 20-30 years are easily attainable for the production of pulpwood (Park and Fowler 1983). Larch, however, is vulnerable to attack by many insects and diseases, including the European larch canker caused by the fungus, Lachnellula willkommii (Hartig) Dennis. The cankers occur on both stems and branches and may result in stem deformities, weak points susceptible to breakage and mortality, as well as a reduction in radial increment of saplings (Boyce 1961).

In Europe, L. willkommii is reported to cause larch canker on L. europaea D.C., L. leptolepis, L. laricina, L. occidentalis Nutt. and L. gmelini (Rupr.) Litvin (Hahn and Ayres 1934; Kurkela 1983). Inoculation experiments show that L. willkommii will infect L. europaea, L. leptolepis, L. laricina, L. occidentalis and L. gmelini (Hahn and Ayres 1936; 1943). Since various provenances of larch demonstrate great differences in growth and form, their susceptibility to the canker, particularly when grown in regions other than their natural range, may also vary. Larix decidua from the high Alps were highly susceptible to canker and dieback in Britain, while those from lower elevations and from Austria showed considerable variability (Pawsey and Young 1969). Trials with L. gmelini in different European countries indicated some resistance, although attacks have been observed (Yde-Andersen 1979).

If larch is to become an important reforestation species in Canada, it may be necessary to select populations that are not susceptible to infection by the European larch canker. We report an early infection of some larch populations by L. willkommii in New Brunswick, Canada.

METHODS

In the spring of 1983, 30 populations representing five species of Larix (Table 1) were planted in an area in southern New Brunswick where native tamarack is heavily infected with European larch canker. The seedlings had been grown in a greenhouse from seed planted in January 1982.

On May 13, 1983, five replicates of each of 10 populations (total of 50 seedlings) were randomly planted throughout a plantation using a Pottiputki planting tool to yield 2 x 2 m spacing with five rows of 10 seedlings; every second row was staggered. On May 19, 10 replicates of an additional 20 populations (total of 200 seedlings), 10 rows of 20 seedlings at 2 x 2 m spacing, were added to those already planted. On June 13, 1985, two populations (total of 25 seedlings) of L. occidentalis, grown from seed planted in February 1985, were added to the plantation.

Seedlings were examined each spring and fall for signs of infection. Each seedling was also rated for vigor by observing the length of the current growth, the condition of the foliage, and the amount of dieback. Seedlings were then scored as 5=excellent, 4=good, 3=fair, 2=poor, and 0=dead.

RESULTS AND DISCUSSION

Snow and freezing temperatures followed by warm spring temperatures during the week after the May 13, 1983 planting were probably responsible for killing 100% of the seedlings in eight of the Larix populations.

During the fall of 1984, one year after planting, the first ascocarps resembling L. willkommii were observed on the stems of three seedlings, one

seedling in each of three populations of L. decidua (Table 2). Microscopic examination of ascocarps confirmed the field identification as L. willkommii.

In the fall of 1985, eight new populations had seedlings infected with the larch canker. Two of the three populations that had seedlings with stem cankers in 1984 had additional seedlings infected in 1985. New stem cankers were observed on 16 seedlings (Table 2). Thirteen seedlings had 1 stem canker each, 2 seedlings had 2 stem cankers each, and, 1 seedling had 3 stem cankers. One seedling that had a stem canker also had a branch canker located on a second order branch (a branch that joins a branch arising from the main stem). The number of infected seedlings per population ranged from 1 to 4.

By the fall of 1985, 11 of the 24 living larch populations had at least one seedling exhibiting ascocarps of L. willkommii (Table 3). Of the 11 infected populations, 8 were L. decidua, 2 were L. laricina, and 1 was L. leptolepis. All populations of L. decidua and L. laricina had at least one seedling infected with the European larch canker. Two years after planting L. eurolepis and one year after planting L. occidentalis, no seedlings showed symptoms of the European larch canker.

The diameter of the stem at the point of infection appears to affect the ability of the canker to kill the cambium tissue during the year of infection. Examination of all stem cankers on infected seedlings showed that 15 of the 23 cankers killed the stem above the canker (Table 2). Of these, 87% of the stems had a diameter of <4.5 mm below the canker. Of the seven cankers where the stem was living above the canker, 86% had a stem diameter of >4.5 mm below the canker. One seedling with a stem

Table 1. Description of larch populations planted in southern New Brunswick to determine susceptibility to European larch canker

Species	Date planted	No. of populations	Origin of seed	No. of seedlings planted
L. decidua	May 1983	8	Czechoslovakia	70
		2	Denmark	15
		1	Canada (Quebec)	5
		1	Germany	5
L. eurolepis	May 1983	2	Scotland	10
		1	Poland	10
		1	Braak	10
L. laricina	May 1983	2	Canada (Ont. Sask.)	20
L. leptolepis	May 1983	8	Japan	75
		3	Denmark	25
L. occidentalis	June 1985	2	USA (Wash., Idaho)	25
L. siberica	May 1983	1	USSR	5

Table 2. Stem infections of the European larch canker on larch populations in 1985 in a plantation in southern New Brunswick

Species	Seed source	Seedling	Symptoms detected[1]	Vigor[2] rating of seedling	Cankers	Living height of seedling (cm)	Height of stem canker (cm)	Diameter of stem below canker (mm)	Condition of stem beyond canker
L. decidua	Denmark	1	Fall 1984	E	1	41	28	2.7	Dead
		2	Spring 1985	E	1	49	28	4.8	Living
		3	Spring 1985	G	1	40	20	4.7	Dead
					2	40	26	2.9	Dead
			Fall 1985	F	3	34	14	6.6	Living
		4	Fall 1985	D	1	37	06	5.0	Dead[3]
		5	Fall 1984	G	1	28	18	3.2	Dead
L. decidua	Czechoslovakia	6	Spring 1985	F	1	33	29	3.5	Dead
			Fall 1985	F	2	33	23	3.6	Dead
		7	Fall 1985	P	1	39	15	4.2	Living
		8	Fall 1985	G	1	38	29	1.7	Dead
		9	Fall 1984	E	1	39	32	2.8	Dead
		10	Fall 1985	G	1	66	12	6.8	Living
		11	Spring 1985	F	1	12	07	3.6	Dead
		12	Spring 1985	G	1	33	12	4.3	Dead
		13	Spring 1985	G	1	26	08	4.4	Living
		14	Fall 1985	P	1	17	18	2.8	Dead
		15	Spring 1985	E	1	53	18	5.0	Dead
					2	53	25	3.0	Dead
		16	Fall 1985	P	1	16	09	3.8	Dead
L. laricina	Canada	17	Spring 1985	E	1	48	26	4.7	Living
		18	Spring 1985	F	1	35	15	6.1	Living
L. leptolepis	Japan	19	Spring 1985	G	1	34	21	4.4	Dead

[1]First observation period when ascocarps of L. willkommii were observed.
[2]Condition of seedling at observation period prior to finding ascocarps (E = excellent, G = good, F = fair, P = poor, D = dead).
[3]Seedling was probably killed by the action of the canker.

canker located 6 cm above the ground was dead, probably as a result of the canker.

Cankers were found on the stem at distances of 16 to 88% of the living height of the seedling with slightly more found on the upper half of the stem than the lower (Table 2).

There does not appear to be a particular time of the year when most of the infections occur. Eleven of the 23 stem cankers were detected for the first time during the fall observation period and the remaining 12 during the spring observation period. Research has shown that ascospores are released predominately during the spring and fall; however, because of their long period of viability, infection can occur throughout the year, particularly during wet periods (Sylvestre-Guinot 1981; Yde-Andersen 1980). It is thought that substances produced by the mycelium cause the bark around the infected spot to become highly sensitive to frost, making the tissue more susceptible to infection by the fungus (Yde-Andersen 1980). During the growing season, wound periderm forming around the canker may stop the advance of the mycelium (Yde-Andersen 1980). However, the manner of infection is uncertain. Although frost wounds may be the principal infection courts, short shoots may also be involved (Yde-Andersen 1980). In our study, the condition of the seedlings did not seem to affect their susceptibility. All vigor classes of seedlings were infected. More than 61% of seedlings infected by the larch canker fungus were rated as having excellent or good vigor during the previous observation period.

Table 3. Infection of Larix populations with the European larch canker, in a larch plantation in southern New Brunswick, Fall 1985

Species	No. of populations planted	No. of populations dead[1]	Condition of remaining populations	
			Infected[2]	Non-infected
L. decidua	12	4	8	0
L. eurolepis	4	2	0	2
L. laricina	2	0	2	0
L. leptolepis	11	1	1	9
L. occidentalis[3]	2	0	0	2
L. siberica	1	1	0	0
Total	32	8	11	13

[1]All seedlings of the population died following snow and freezing temperatures 4 and 5 days after the May 13, 1983 planting.
[2]Nunber of populations with at least one seedling infected with the larch canker.
[3]Species exposed in field for only one year.

CONCLUSIONS

Earlier studies have shown that the European larch canker incepted on L. decidua stems as young as 3 yr of age (Yde-Andersen 1980). Ostaff (1985) showed that canker inception occurred on tamarack stems as young as 2 yrs of age. This paper shows that seedlings, planted one year after being grown from seed, from some populations of larch can become infected by the European larch canker and ascocarps may be produced as early as one year after planting. The early infection of some larch populations suggests that careful selection and screening of larch species and seed sources are required before any large-scale planting is undertaken in areas where the canker is present. Also, seedlings grown in infected areas may be a means of disseminating the disease to other areas unless proper precautions are taken.

ACKNOWLEDGEMENTS

We thank J.D. Irving Ltd. for supplying the larch seedlings; J.E. Hurley for the identification of the fungus and, L.P. Magasi for advice and review of the manuscript.

REFERENCES

Boyce, J.S. 1961. Forest pathology. 3rd ed. Toronto: McGraw-Hill Book Co. Inc.

Hahn, G.G.; Ayres, T.T. 1934. Dasyscyphae on conifers in North America. I. The large-spored, white-excipled species. Mycologia 26: 73-166.

Hahn, G.G.; Ayres, T.T. 1936. The European larch canker and its relation to certain other cankers of conifers in the United States. J. Forestry 34:898-908.

Hahn, G.G.; Ayres, T.T. 1943. Role of Dasyscypha willkommii and related fungi in the production of canker and dieback of larch. J. Forestry 41:483-495.

Kurkela, T. 1983. European larch canker-The situation in Europe. In: European Larch Canker Workshop. Proceedings No. 3, Marit. For. Res. Cent., Fredericton, N.B. June 28-29, 1983.

Ostaff, D.P. 1985. Age distribution of European larch canker in New Brunswick. Plant Disease 69: 796-798.

Park, Y.S.; Fowler, D.P. 1983. A provenance test of Japanese larch in eastern Canada, including comparative data on European larch and tamarack. Silvae Genetica 32(3-4): 96-101.

Pawsey, R.G.; Young, C.W.T. 1969. A reappraisal of canker and dieback of European larch. Forestry 42: 145-164.

Simpson, J.D. 1982. The New Brunswick Tree Improvement Council's breeding strategy for tamarack. pp. 219-224. In: Proceedings of the 28th Northeastern Forest Tree Improvement Conference, Institute of Natural and Environmental Resources, Univ. of New Hampshire, Durham, New Hampshire. July 7-9, 1982.

Sylvestre-Guinot, G. 1981. Étude de l'émission des ascospores du Lachnellula willkommii (Hartig) Dennis dans l'Est de la France. Eur. J. Path. 11: 275-283.

Yde-Andersen, A. 1979. Host spectrum, host morphology and geographic distribution of larch canker, Lachnellula willkommii - A literature review. Eur. J. For. Pathol. 9: 211-219.

Yde-Andersen, A. 1980. Infection process and the influence of frost damage in Lachnellula willkommii: A literature review. Eur. J. For. Pathol. 10: 28-36.